

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C. 20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year)

21 September 1999 (21.09.99)

International application No.

PCT/GB99/00194

Applicant's or agent's file reference

10858 PCT

International filing date (day/month/year)

20 January 1999 (20.01.99)

Priority date (day/month/year)

04 February 1998 (04.02.98)

Applicant

PARTINGTON, Kenneth, Michael et al

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

20 August 1999 (20.08.99)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Lazar Joseph Panakal

Telephone No.: (41-22) 338.83.38

WO 99/40638
PCT/GB99/00194

PATENT COOPERATION TREATY

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NOTICE INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

TREVES, Barry, William
BTR Group Intellectual Property
Knights House
2 Parade
Sutton Coldfield
West Midlands B72 1PH
ROYAUME-UNIINTELLECTUAL
PROPERTY

20 AUG 1999

Date of mailing (day/month/year) 12 August 1999 (12.08.99)		MS-1-	
Applicant's or agent's file reference 10858 PCT		IMPORTANT NOTICE	
International application No. PCT/GB99/00194	International filing date (day/month/year) 20 January 1999 (20.01.99)	Priority date (day/month/year) 04 February 1998 (04.02.98)	
Applicant CHLORIDE INDUSTRIAL BATTERIES LIMITED et al			

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
AU,CN,EP,IL,JP,KP,KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GD,GE,GH,GM,HR,HU,
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SE,SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZW
The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
12 August 1999 (12.08.99) under No. WO 99/40638

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 10858 PCT	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 99/ 00194	International filing date (day/month/year) 20/01/1999	(Earliest) Priority Date (day/month/year) 04/02/1998
Applicant CHLORIDE INDUSTRIAL BATTERIES LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

BATTERY WITH TOP AND BOTTOM CONNECTING STRAPS AND ADDITIONAL VERTICAL CONNECTING BARS

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/00194

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H01M2/22 H01M2/28 H01M2/26 H01M10/12 H01M10/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 442 599 A (DELANS DARWIN D) 21 August 1991 see claims see figures ---	1-13
Y	US 4 760 001 A (NANN EBERHARD ET AL) 26 July 1988 see column 1, line 25-63 see figures ---	1-3
Y	GB 1 590 947 A (AUERBACH J) 10 June 1981 see page 1, line 44-80 see claims ---	1-3
Y	EP 0 083 330 A (TUDOR AB) 6 July 1983 see page 1 see claims; figures -----	1-3

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

21 April 1999

Date of mailing of the international search report

29/04/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Engl, H

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

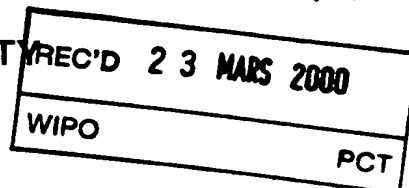
PCT/GB 99/00194

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
EP 0442599	A	21-08-1991	US	4983475 A		08-01-1991
			CA	2033674 A		14-08-1991
			DE	69106163 D		09-02-1995
			DE	69106163 T		18-05-1995
			JP	2786022 B		13-08-1998
			JP	6203824 A		22-07-1994

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			AT	69670 T		15-12-1991
			AU	592856 B		25-01-1990
			AU	7045287 A		08-10-1987
			CA	1280803 A		26-02-1991
			EP	0247327 A		02-12-1987
			JP	2114415 C		06-12-1996
			JP	8012780 B		07-02-1996
			JP	62237668 A		17-10-1987
			KR	9504628 B		03-05-1995


GB 1590947	A	10-06-1981	AT	361061 B		25-02-1981
			AT	786077 A		15-07-1980
			BE	860587 A		08-05-1978
			CH	629340 A		15-04-1982
			DE	2749179 A		19-10-1978
			FR	2370368 A		02-06-1978
			SE	7711720 A		08-05-1978

EP 0083330	A	06-07-1983	SE	445276 B		09-06-1986
			AT	27667 T		15-06-1987
			SE	8107784 A		29-06-1983



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 10858 PCT		FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/00194	International filing date (day/month/year) 20/01/1999	Priority date (day/month/year) 04/02/1998	
International Patent Classification (IPC) or national classification and IPC H01M2/22			
Applicant CHLORIDE INDUSTRIAL BATTERIES LIMITED et al.			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 8 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application 			
Date of submission of the demand 20/08/1999		Date of completion of this report 20.03.00	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized officer Engl, H Telephone No. +49 89 2399 8567	



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/00194

1. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-4	as received on	04/02/2000	with letter of	01/02/2000
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Claims, No.:

1-15	as received on	04/02/2000	with letter of	01/02/2000
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Drawings, sheets:

1/2,2/2	as received on	04/02/2000	with letter of	01/02/2000
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2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/00194

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-15
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-15
Industrial applicability (IA)	Yes:	Claims	1-15
	No:	Claims	

2. Citations and explanations

see separate sheet

REGARDING SECTION V

1. CITATIONS

D1: EP-A-0442599

D2: US-A-4760001

2. NOVELTY AND INVENTIVE STEP

D1 is considered to represent the closest prior art. D1 discloses (see in particular Fig. 3) an electrochemical battery (30) having a plurality of alternating positive and negative plates (40,50); at least one tab (51,45) protruding from one edge of each of the positive and negative plates; at least one tab (27,42) protruding from an opposite edge of each of the positive and negative plates; a pair of negative plate straps (32A,B) connecting together each tab protruding from each negative plate; a pair of positive plate straps (36A,B) connecting together each tab protruding from each positive plate; a first diagonal bar (34) connecting together the pair of negative plate straps; and a second diagonal bar (38) connecting together the pair of positive plate straps. A key advantage of the invention disclosed in D1 is that resistance is reduced and electrical characteristics of the battery are improved under load conditions. Another advantage is that a manufacturer of conventional batteries either can use existing top-mounted terminal posts or can support side-mounted terminal posts with the diagonal bars.

The first and second diagonal bars (34, 38) correspond to the conductive members (25, 28) of the present application; they solve the same technical problem, i.e., to increase the electrical conductivity along the plates (see col. 2, lines 36 - 40). D1 also discloses (see col. 6) the connection of the positive and negative plates, respectively, not only by straps at the top, but also at the bottom of the plates, which is another key feature of the present application. Lead acid accumulators with bottom connectors (top and bottom connecting straps) to decrease the conductive resistance of the plates, especially when the batteries are relatively high, are also known from D4 (see Fig. 1, 2 and page 1).

In accordance with the forth embodiment disclosed at col. 12, lines 21 ff of D1, it is

specifically suggested that the material of the diagonal bars should be made of lead-plated copper, a material known to have a conductivity greater than the material of the positive and/or negative plates (lead).

The subject matter of current claims 1 - 15 differs from the prior art described in D1 in that the connecting members (25; 28) extend substantially parallel, not diagonally, with respect to the long edges (16a) of the plates.

Therefore, the subject matter of claims 1 - 15 is novel. The requirement of Article 33(2) is met. Moreover, lead-plated copper is not disclosed in connection with embodiments one, two and three of D1. In embodiment four, the connecting members run outside the battery's housing; however, the diagonal bars for the first, second and third embodiments of D1 are all placed inside the outer cover of the battery and are made of solid lead (see col. 12, lines 26 - 33).

The fact that claim 1 does not specifically mention similar members connecting also the negative plates is not a feature distinguishing the application from D1. As a matter of fact, such connecting members being present at both the negative and positive plates is a preferred embodiment of the present application, which is defined and claimed in dependent claim 2.

None of the above described novelty-conferring features is considered to involve an inventive step. Bearing in mind the technical object of the diagonal bar construction disclosed in D1, it would be obvious to those of skill in the art that a low resistance path for an electric current to flow to the terminal posts can most efficiently be achieved when the conductivity of the material of the bars is high. Since the cross section of these bars is necessarily smaller than the sum of the cross sections of the plates, it is clear that - in order to maximize the desired effect - the conductivity of the bars should preferably be higher than the conductivity of the plates. Copper or aluminium are obvious choices for metals having high electrical conductivity (see also D2, suggesting copper plates to increase the conductivity of an expanded metal grid plate). It is self-evident that these metals, especially when anodic, must be protected from contact with the (acidic) electrolyte, by an inert sheath material (inert or passive metal, or resin or lacquer). It is within the competence of the skilled person to select the most appropriate

sheathing material, for instance against sulfuric acid electrolyte.

The parallel arrangement of the connecting members (26; 28) is an obvious geometric alternative to the diagonal design presented in D1. The choice would be made by those of skill in the art depending on the available space and requires no more than routine development and expertise.

Therefore, neither independent claim 1 nor any of the dependent claims 2 - 15 involve an inventive step, having regard to the cited art and the skilled person's general knowledge.

The requirement of Art. 33(3) PCT is therefore not met.

3. INDUSTRIAL APPLICABILITY

The claimed subject matter finds industrial application in the field of energy storage and conversion. **The requirement of Art. 33(4) PCT is thus met.**

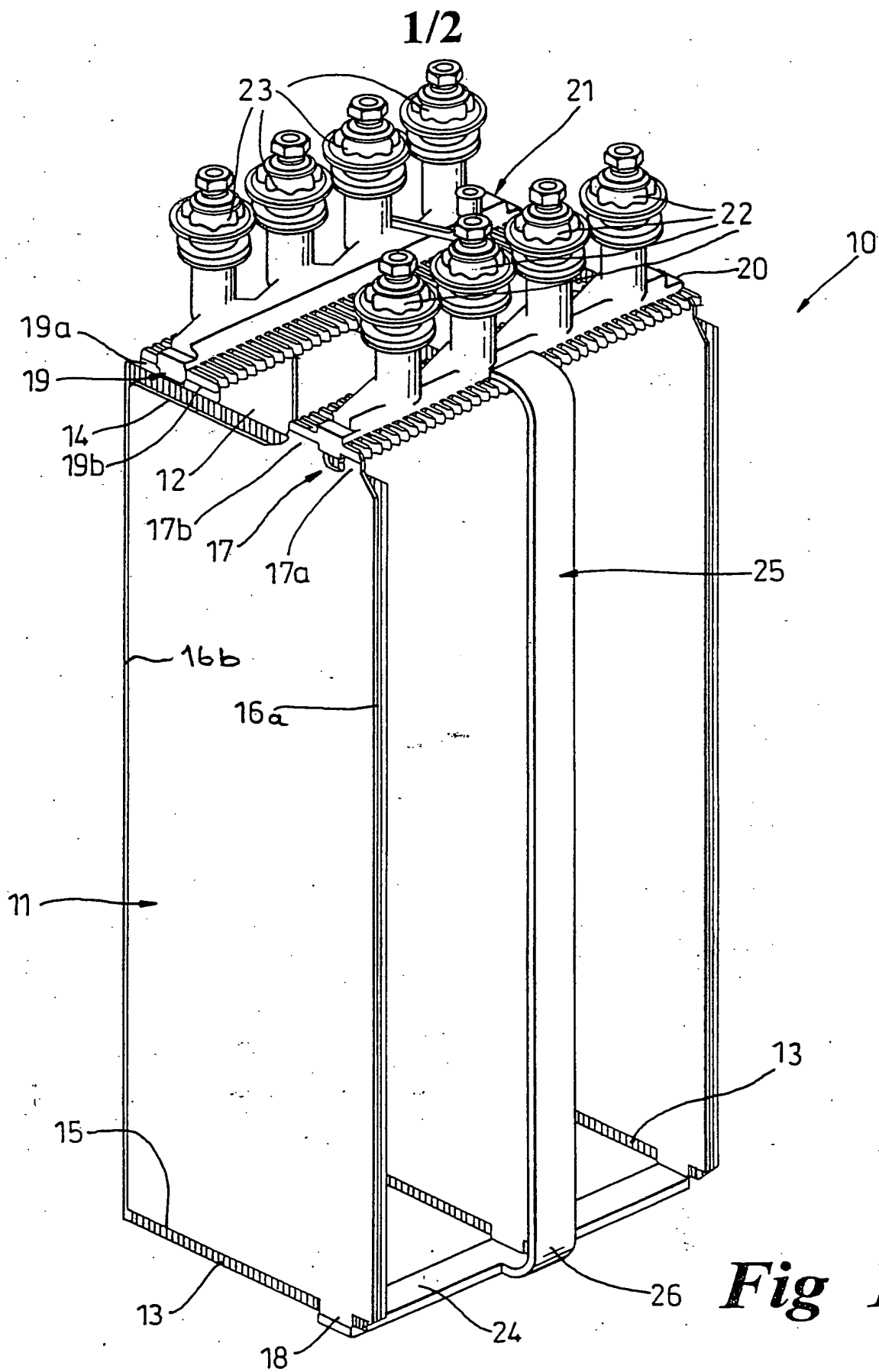
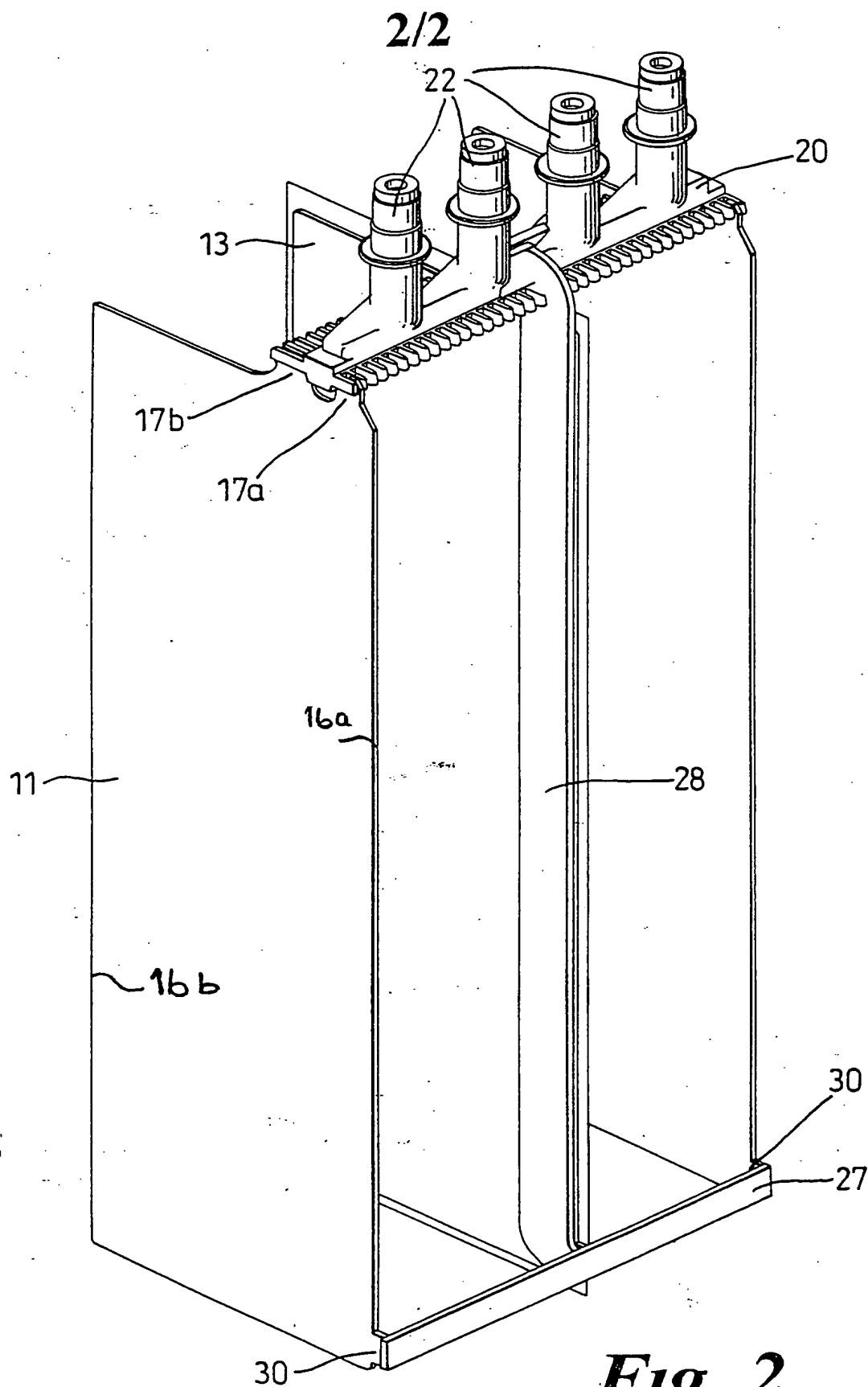


Fig 1



AMENDED SHEET

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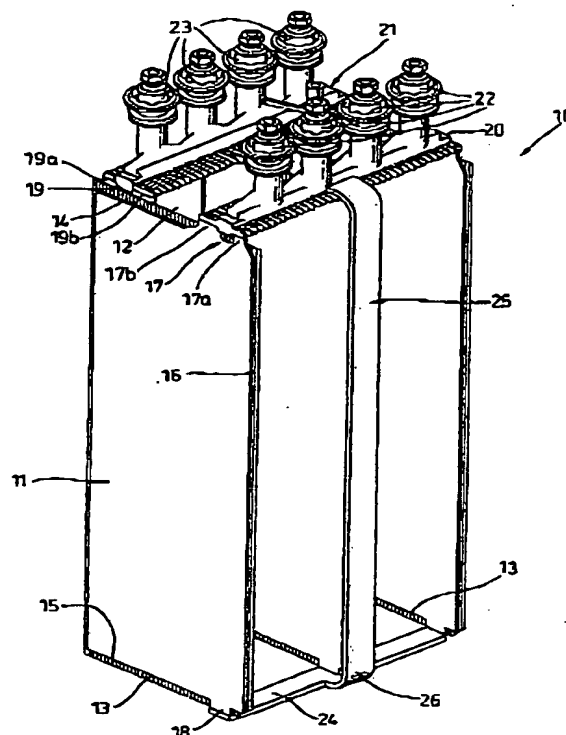
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H01M 2/22, 2/28, 2/26, 10/12, 10/04		A1	(11) International Publication Number: WO 99/40638
			(43) International Publication Date: 12 August 1999 (12.08.99)
(21) International Application Number: PCT/GB99/00194 (22) International Filing Date: 20 January 1999 (20.01.99) (30) Priority Data: 9802362.5 4 February 1998 (04.02.98) GB (71) Applicant (for all designated States except US): CHLORIDE INDUSTRIAL BATTERIES LIMITED [GB/GB]; BTR House, Carlisle Place, London SW1P 1BX (GB). (72) Inventors; and (75) Inventors/Applicants (for US only): PARTINGTON, Kenneth. Michael [GB/GB]; 55 Little Lane, Longbridge, Lancashire PR3 3WS (GB). SMITH, David, Colin [GB/GB]; 8 Willowmead Way, Norden, Rochdale, Lancashire OL12 7PX (GB). (74) Agent: TREVES, Barry, William; BTR Group Intellectual Property, Knights House, 2 Parade, Sutton Coldfield, West Midlands B72 1PH (GB).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DE (Utility model), DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW. ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published With international search report.	

(54) Title: BATTERY WITH TOP AND BOTTOM CONNECTING STRAPS AND ADDITIONAL VERTICAL CONNECTING BARS

(57) Abstract

A battery (10) having positive and negative plates (11, 12) contained in a housing. The upper edges of the positive plates are connected to the lower edges by means of a member (25; 28) also contained in the housing. The member (25; 28) comprises a material having a greater conductivity than that of the material of the plates.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

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DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

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REPLACED 09/601477
2/PRT) ART 34 AMDT PCT/GB99/00194

534 Rec'd PCT/PTC 03 AUG 2000

BATTERY WITH TOP AND BOTTOM CONNECTING STRAPS AND ADDITIONAL VERTICAL CONNECTING BARS

This invention relates to a battery (also known as an accumulator), particularly but not exclusively of the lead acid type.

One known lead acid battery comprises a plurality of rectangular lead plates arranged parallel to one another and separated by insulating separating sheets. Alternate plates are positive and negative electrodes respectively, all the positive electrodes being connected together electrically by a first connector and all the negative electrodes being connected together electrically by a second connector, the two connectors being connected to positive and negative terminals respectively.

If the plates, all rectangular, are relatively long and narrow, and the connector and/or terminal is connected to a narrow edge, then there is a relatively long conducting path for the current from the area of the plate adjacent the opposite narrow edge to the connector or terminal. Since the conductivity of lead is significantly less than that of a metal such as copper or aluminium, there is a limit to the current carrying capacity of each electrode, since increasing the current increases the heat generated within the plates. Thus, particularly where other factors dictate that a battery has electrodes which are long and narrow, and the terminals or connectors are attached to a narrow edge of the electrodes, and further if the battery is located in a confined space, the limit on the current carrying capacity is a considerable disadvantage.

It is an object of the present invention to provide a battery in which the adverse effects of this disadvantage are reduced, i.e. the current carrying capacity is increased.

In accordance with the invention a battery comprises a housing containing a plurality of positive plates connected in parallel and a plurality of negative plates connected in parallel, the positive plates each being of substantially the same size and rectangular shape having two long edges and a first short edge and a second short edge, and the housing also containing a member having a first end and a second end, the first end being electrically connected to the first short edges of the positive plates and the second end

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2

being electrically connected to the second short edges of the positive plates or to one of the long edges of the positive plates immediately adjacent to the second short edges, the member consisting of a material which has a greater conductivity than the material of the positive plates.

The negative plates may each be substantially the same size and rectangular shape having two long edges and a first short edge and a second short edge, and a further member may be provided, the further member having a first end and a second end, the first end being electrically connected to the first short edges of the negative plates and the second end being electrically connected to the second short edges of the negative plates or to one of the long edges of the negative plates immediately adjacent to the second short edges, the further member consisting of a material which has a greater conductivity than the material of the negative plates.

The negative plates and the positive plates may all be substantially the same size and rectangular shape.

The first short edges of the positive plates may be connected by a first connector which is electrically connected to a positive terminal of the battery.

The second short edges of the positive plates may be connected by a further connector which is either of the same general material as the positive plates, e.g. in the case of a lead acid battery the material is lead, or, alternatively, of the same general material as the member.

If the battery is a lead acid battery, the member preferably comprises copper, or a copper alloy such as brass, or aluminium or an alloy thereof, covered in a lead sheath. The sheath may be covered in an acid resistant material such as an epoxy resin.

Two embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, of which

Figure 1 shows a perspective view of the interior of a lead acid battery according to the first embodiment of the invention, some of the parts being omitted for clarity; and

Figure 2 shows a perspective view of the interior of a battery according

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to the second embodiment, only the arrangement of positive plates and attachments being shown.

As shown in Figure 1, the first embodiment of the invention comprises a lead acid battery 10 having a plurality of plates 11 and 12 alternately interleaved with separators 13 comprising sheets of microporous polyethylene and of non-woven glass fibre. The plates 11 and 12 and separators 13 are positioned in face-to-face arrangement and alternate plates are of positive and negative polarity, the positive plates being indicated by reference numeral 11 and the negative plates by reference numeral 12.

The plates and separators are housed in a rectangular container of plastics material (not shown) containing acid (not shown).

All the plates 11 and 12 are generally rectangular in shape and of generally the same size. The horizontal top edge 14 and bottom edge 15 of the plates (as shown) are much shorter than the vertical edges 16. The positive plates 11 are each provided on the top edge with a tag 17, having two parts 17a and 17b, adjacent a corner with a long edge. Directly below, each positive plate is provided on its lower edge with a tag 18 adjacent the corner with the same long edge. The plates are arranged so that the two tags are arranged in two rows, one row directly above the other. The negative plates are each formed with one tag 19 having two parts 19a and 19b on the top edge adjacent the corner with a long edge and the plates are arranged so that the tags 19 form a single row parallel to and spaced apart from the row of tags 17 on the upper edges of the positive plates.

The tags in each upper row lie in general side-by-side arrangement and are each connected by respective connectors 20 and 21. Two sets of terminals 22 and 23 are integrally formed with the respective connectors 20 and 21, the connectors and terminals being formed by a casting operation. The terminals and connectors are of high conductivity copper, embedded in a lead sheath by a casting process.

Connected to the lower row of tags 18 on the positive plates 11 is a further connector 24 in the form of a strip of lead or lead-sheathed copper which

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is connected by means of a member in the form of a strip 25 of lead-sheathed copper to the connector at the top of the positive plates 11. The connector 24 and member 25 are joined by any suitable process to one another, to the lower row of tags and to the upper row of tags to make good electrical connections. The lead sheath prevents corrosion by the acid.

As can be seen in the drawing, the further connector 24 lies in a horizontal plane perpendicular to the plane of the plate and the member 25 lies in a vertical plane perpendicular to the plane of the plate except for a small section 26 where it is curved for connection to the further connector 24.

In the second embodiment of the invention, shown in Figure 2, the member of the first embodiment is replaced by a lead sheathed copper strip member 28 having the same general shape and dimensions but positioned between a negative plate 12 and a positive plate 11 (as shown) or at one end of the row of plates so as to lie parallel thereto, and separated from the plates by one or more separating sheets. The tags 18 on the lower edges of the positive plates 11 are replaced by tags 30 on a longer side, adjacent the corner with the lower edge. These tags 30 are connected to a lead sheathed copper or lead strip connector 27 which lies alongside the longer sides of the plates 11 and 12, rather than alongside the lower edge as in the first embodiment.

In this second embodiment any problems associated with plate growth and/or the deposition of debris, are alleviated.

In either embodiment the high conductivity strip member 25 or 28 of copper sheathed with lead may be connected to the lead sheath of the connector 20 or to the copper connector 20 itself. The latter construction has the greater conductivity.

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CLAIMS:

1. A battery (10) comprising a housing containing a plurality of positive plates (11) connected in parallel and a plurality of negative plates (12) connected in parallel, the positive plates each being of substantially the same size and rectangular shape having two long edges (16) and a first short edge (14) and a second short edge (15), characterised in that the housing also contains a member (25;28) having a first end and a second end, the first end being electrically connected to the first short edges (14) of the positive plates (11) and the second end being electrically connected to the second short edges (15) of the positive plates (11) or to one of the long edges (16) of the positive plates (11) immediately adjacent to the second short edges (15), the member (25;28) consisting of a material which has a greater conductivity than the material of the positive plates (11).
- 2 A battery (10) according to Claim 1 characterised in that the negative plates (12) are each substantially the same size and rectangular shape having two long edges (16) and a first short edge (14) and a second short edge (15), and a further member (25;28) may be provided, the further member having a first end and a second end, the first end being electrically connected to the first short edges (14) of the negative plates (12) and the second end being electrically connected to the second short edges (15) of the negative plates (12) or to one of the long edges (16) of the negative plates (12) immediately adjacent to the second short edges (15), the further member (25;28) consisting of a material which has a greater conductivity than the material of the negative plates (12).
3. A battery (10) according to either Claim 1 or Claim 2 characterised in that the negative plates (12) and the positive plates (11) are all substantially the same size and rectangular shape.
4. A battery (10) according to any one of the preceding claims characterised in that the first short edges (14) of the positive plates are connected by a connector (20) which is electrically connected to a positive terminal (22) of the battery (10).
5. A battery (10) according to any one of the preceding claims characterised

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in that the second short edges (15) of the positive plates (12) are connected by a further connector (24).

6. A battery (10) according to Claim 5 characterised in that the further connector (24) is of the same general material as the positive plates (12).

7. A battery (10) according to Claim 5 characterised in that the second connector (24) is of the same general material as the member (25).

8. A battery (10) according to any one of the preceding claims which is a lead acid battery.

9. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises copper covered in a lead sheath.

10. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises a copper alloy such as brass, covered in a lead sheath.

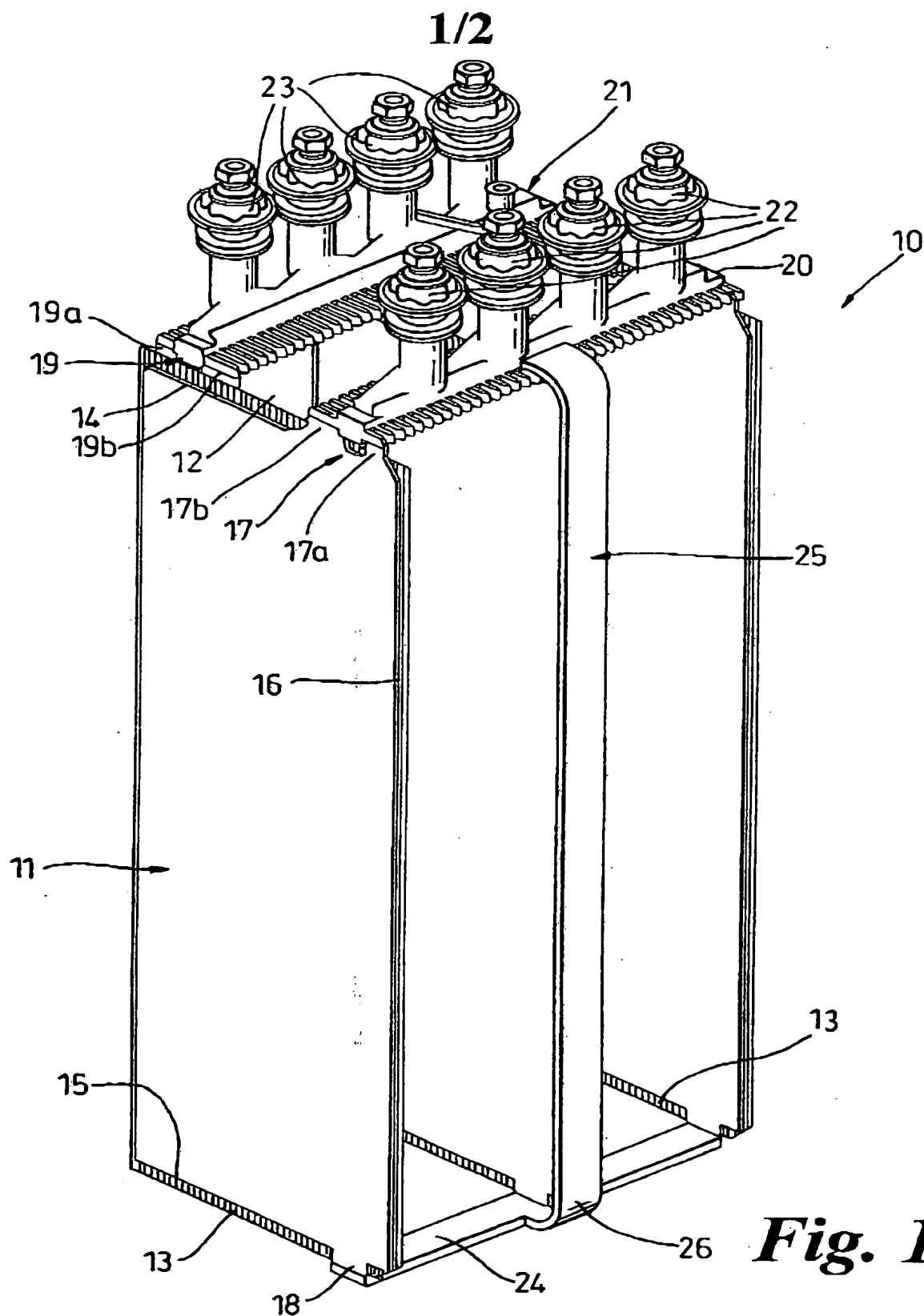
11. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises aluminium covered in a lead sheath.

12. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises an aluminium alloy covered in a lead sheath.

13. A battery (10) according to any one of Claims 9 to 12 characterised in that the sheath is covered in an acid resistant material such as an epoxy resin.

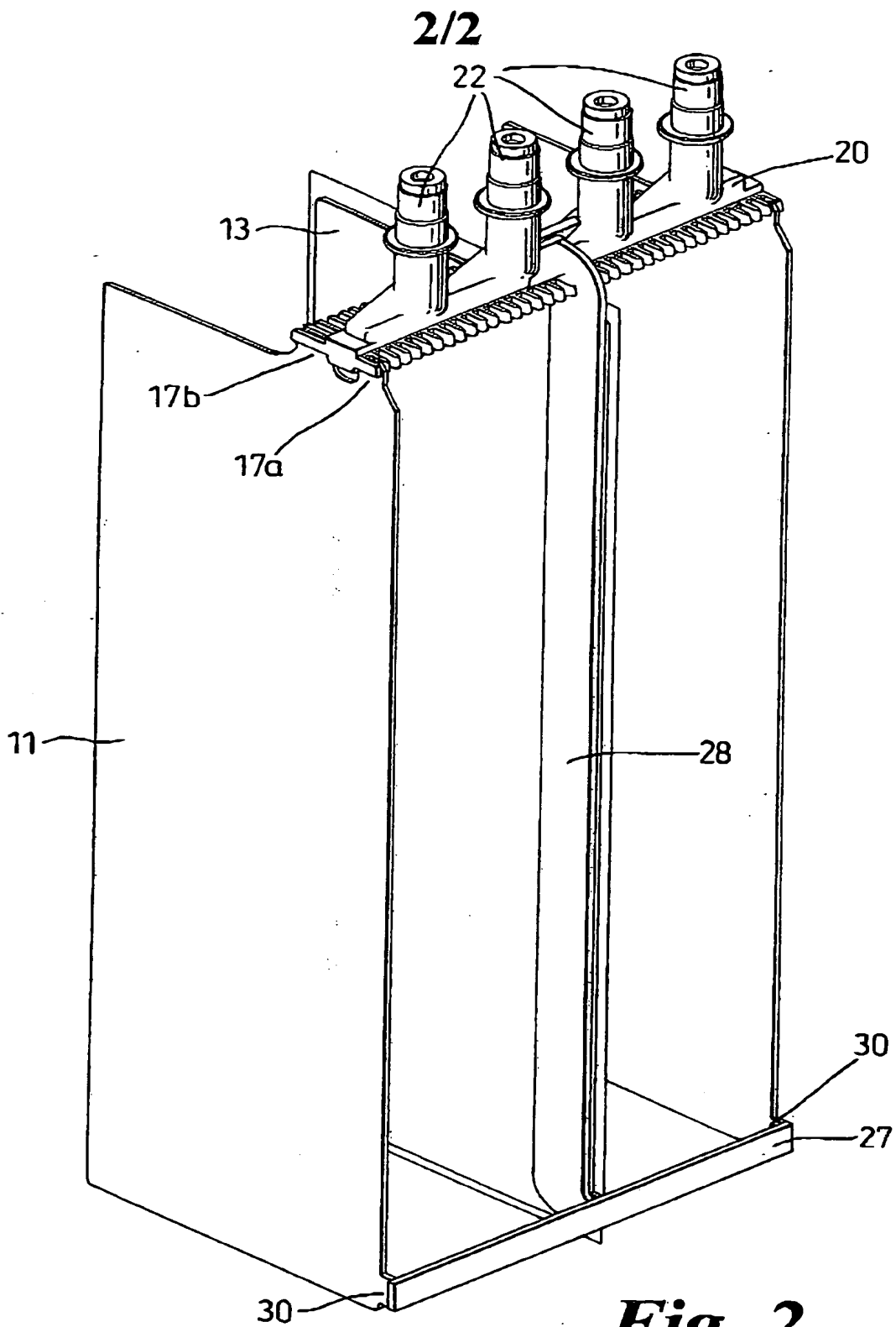
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**Fig. 2**

INTERNATIONAL SEARCH REPORT

National Application No

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A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H01M2/22 H01M2/28 H01M2/26 H01M10/12 H01M10/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 442 599 A (DELANS DARWIN D) 21 August 1991 see claims see figures	1-13
Y	US 4 760 001 A (NANN EBERHARD ET AL) 26 July 1988 see column 1, line 25-63 see figures	1-3
Y	GB 1 590 947 A (AUERBACH J) 10 June 1981 see page 1, line 44-80 see claims	1-3
Y	EP 0 083 330 A (TUDOR AB) 6 July 1983 see page 1 see claims; figures	1-3

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"Z" document member of the same patent family

Date of the actual completion of the international search

21 April 1999

Date of mailing of the international search report

29/04/1999

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/00194



Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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			CA 2033674 A	14-08-1991
			DE 69106163 D	09-02-1995
			DE 69106163 T	18-05-1995
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			AT 27667 T	15-06-1987
			SE 8107784 A	29-06-1983

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 10858 PCT		FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/00194	International filing date (day/month/year) 20/01/1999	Priority date (day/month/year) 04/02/1998	
International Patent Classification (IPC) or national classification and IPC H01M2/22			
Applicant CHLORIDE INDUSTRIAL BATTERIES LIMITED et al.			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 8 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <p>I <input checked="" type="checkbox"/> Basis of the report</p> <p>II <input type="checkbox"/> Priority</p> <p>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p>IV <input type="checkbox"/> Lack of unity of invention</p> <p>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p>VI <input type="checkbox"/> Certain documents cited</p> <p>VII <input type="checkbox"/> Certain defects in the international application</p> <p>VIII <input type="checkbox"/> Certain observations on the international application</p>			
Date of submission of the demand 20/08/1999		Date of completion of this report 20.03.00	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized officer Engl. H Telephone No. +49 89 2399 8567 	

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/00194

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-4 as received on 04/02/2000 with letter of 01/02/2000

Claims, No.:

1-15 as received on 04/02/2000 with letter of 01/02/2000

Drawings, sheets:

1/2,2/2 as received on 04/02/2000 with letter of 01/02/2000

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/00194

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Yes:	Claims	1-15
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-15
Industrial applicability (IA)	Yes:	Claims	1-15
	No:	Claims	

2. Citations and explanations**see separate sheet**

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/00194

REGARDING SECTION V**1. CITATIONS**

D1: EP-A-0442599

D2: US-A-4760001

2. NOVELTY AND INVENTIVE STEP

D1 is considered to represent the closest prior art. D1 discloses (see in particular Fig. 3) an electrochemical battery (30) having a plurality of alternating positive and negative plates (40,50); at least one tab (51,45) protruding from one edge of each of the positive and negative plates; at least one tab (27,42) protruding from an opposite edge of each of the positive and negative plates; a pair of negative plate straps (32A,B) connecting together each tab protruding from each negative plate; a pair of positive plate straps (36A,B) connecting together each tab protruding from each positive plate; a first diagonal bar (34) connecting together the pair of negative plate straps; and a second diagonal bar (38) connecting together the pair of positive plate straps. A key advantage of the invention disclosed in D1 is that resistance is reduced and electrical characteristics of the battery are improved under load conditions. Another advantage is that a manufacturer of conventional batteries either can use existing top-mounted terminal posts or can support side-mounted terminal posts with the diagonal bars.

The first and second diagonal bars (34, 38) correspond to the conductive members (25, 28) of the present application; they solve the same technical problem, i.e., to increase the electrical conductivity along the plates (see col. 2, lines 36 - 40). D1 also discloses (see col. 6) the connection of the positive and negative plates, respectively, not only by straps at the top, but also at the bottom of the plates, which is another key feature of the present application. Lead acid accumulators with bottom connectors (top and bottom connecting straps) to decrease the conductive resistance of the plates, especially when the batteries are relatively high, are also known from D4 (see Fig. 1, 2 and page 1).

In accordance with the forth embodiment disclosed at col. 12, lines 21 ff of D1, it is

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/00194

specifically suggested that the material of the diagonal bars should be made of lead-plated copper, a material known to have a conductivity greater than the material of the positive and/or negative plates (lead).

The subject matter of current claims 1 - 15 differs from the prior art described in D1 in that the connecting members (25; 28) extend substantially parallel, not diagonally, with respect to the long edges (16a) of the plates.

Therefore, the subject matter of claims 1 - 15 is novel. The requirement of Article 33(2) is met. Moreover, lead-plated copper is not disclosed in connection with embodiments one, two and three of D1. In embodiment four, the connecting members run outside the battery's housing; however, the diagonal bars for the first, second and third embodiments of D1 are all placed inside the outer cover of the battery and are made of solid lead (see col. 12, lines 26 - 33).

The fact that claim 1 does not specifically mention similar members connecting also the negative plates is not a feature distinguishing the application from D1. As a matter of fact, such connecting members being present at both the negative and positive plates is a preferred embodiment of the present application, which is defined and claimed in dependent claim 2.

None of the above described novelty-conferring features is considered to involve an inventive step. Bearing in mind the technical object of the diagonal bar construction disclosed in D1, it would be obvious to those of skill in the art that a low resistance path for an electric current to flow to the terminal posts can most efficiently be achieved when the conductivity of the material of the bars is high. Since the cross section of these bars is necessarily smaller than the sum of the cross sections of the plates, it is clear that - in order to maximize the desired effect - the conductivity of the bars should preferably be higher than the conductivity of the plates. Copper or aluminium are obvious choices for metals having high electrical conductivity (see also D2, suggesting copper plates to increase the conductivity of an expanded metal grid plate). It is self-evident that these metals, especially when anodic, must be protected from contact with the (acidic) electrolyte, by an inert sheath material (inert or passive metal, or resin or lacquer). It is within the competence of the skilled person to select the most appropriate

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EXAMINATION REPORT - SEPARATE SHEET

sheathing material, for instance against sulfuric acid electrolyte.

The parallel arrangement of the connecting members (26; 28) is an obvious geometric alternative to the diagonal design presented in D1. The choice would be made by those of skill in the art depending on the available space and requires no more than routine development and expertise.

Therefore, neither independent claim 1 nor any of the dependent claims 2 - 15 involve an inventive step, having regard to the cited art and the skilled person's general knowledge.

The requirement of Art. 33(3) PCT is therefore not met.

3. INDUSTRIAL APPLICABILITY

The claimed subject matter finds industrial application in the field of energy storage and conversion. **The requirement of Art. 33(4) PCT is thus met.**

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BATTERY

This invention relates to a battery (also known as an accumulator), particularly but not exclusively of the lead acid type.

One known lead acid battery comprises a plurality of rectangular plates arranged parallel to one another and separated by insulating separating sheets. Alternate plates are positive and negative electrodes respectively, all the positive electrodes being connected together electrically by a first connector and all the negative electrodes being connected together electrically by a second connector, the two connectors being connected to positive and negative terminals respectively.

If the plates, all rectangular, are relatively long and narrow, and the connector and/or terminal is connected to a narrow edge, then there is a relatively long conducting path for the current from the area of the plate adjacent the opposite narrow edge to the connector or terminal. Since the conductivity of lead is significantly less than that of a metal such as copper or aluminium, there is a limit to the current carrying capacity of each electrode, since increasing the current increases the heat generated within the plates. Thus, particularly where other factors dictate that a battery has electrodes which are long and narrow, and the terminals or connectors are attached to a narrow edge of the electrodes, and further if the battery is located in a confined space, the limit on the current carrying capacity is a considerable disadvantage.

EP-A-044259 discloses a battery having a plurality of alternating positive and negative plates; at least one tab protruding from one edge of each of the positive and negative plates; at least one tab protruding from an opposite edge of each of the positive and negative plates; a pair of negative plate straps connecting together each tab protruding from each negative plate; a pair of positive plate straps connecting together each tab protruding from each positive plate; a first diagonal bar connecting together the pair of negative plate straps; and a second diagonal bar connecting together the pair of positive plate straps.

It is an object of the present invention to provide a battery having an improved current carrying capacity.

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In accordance with the invention a battery comprises a housing containing a plurality of positive plates connected in parallel and a plurality of negative plates connected in parallel, the positive plates each being of substantially the same size and rectangular shape having two long edges and a first short edge and a second short edge, and the housing also containing a member having a first end and a second end, the first end being electrically connected to the first short edges of the positive plates adjacent one of the two sets of long edges and the second end being electrically connected to the second short edges of the positive plates adjacent the same set of long edges or to the same set of long edges of the positive plates immediately adjacent to the second short edges, the member extending parallel to the said long edges for most of its length and consisting of a material which has a greater conductivity than the material of the positive plates.

The negative plates may each be substantially the same size and rectangular shape having two long edges and a first short edge and a second short edge, and a further member may be provided, the further member having a first end and a second end, the first end being electrically connected to the first short edges of the negative plates and the second end being electrically connected to the second short edges of the negative plates or to one of the long edges of the negative plates immediately adjacent to the second short edges, the further member consisting of a material which has a greater conductivity than the material of the negative plates.

The negative plates and the positive plates may all be substantially the same size and rectangular shape.

The first short edges of the positive plates may be connected by a first connector which is electrically connected to a positive terminal of the battery.

The second short edges of the positive plates may be connected by a further connector which is either of the same general material as the positive plates, e.g. in the case of a lead acid battery the material is lead, or, alternatively, of the same general material as the member.

If the battery is a lead acid battery, the member preferably comprises copper, or a copper alloy such as brass, or aluminium or an alloy thereof,

AMENDED SHEET

covered in a lead sheath. The sheath may be covered in an acid resistant material such as an epoxy resin.

Two embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, of which

Figure 1 shows a perspective view of the interior of a lead acid battery according to the first embodiment of the invention, some of the parts being omitted for clarity; and

Figure 2 shows a perspective view of the interior of a battery according to the second embodiment, only the arrangement of positive plates and attachments being shown.

As shown in Figure 1, the first embodiment of the invention comprises a lead acid battery 10 having a plurality of plates 11 and 12 alternately interleaved with separators 13 comprising sheets of microporous polyethylene and of non-woven glass fibre. The plates 11 and 12 and separators 13 are positioned in face-to-face arrangement and alternate plates are of positive and negative polarity, the positive plates being indicated by reference numeral 11 and the negative plates by reference numeral 12.

The plates and separators are housed in a rectangular container of plastics material (not shown) containing acid (not shown).

All the plates 11 and 12 are generally rectangular in shape and of generally the same size. The horizontal top edge 14 and bottom edge 15 of the plates (as shown) are much shorter than the vertical edges 16. The positive plates 11 are each provided on the top edge with a tag 17, having two parts 17a and 17b, adjacent a corner with a long edge. Directly below, each positive plate is provided on its lower edge with a tag 18 adjacent the corner with the same long edge. The plates are arranged so that the two tags are arranged in two rows, one row directly above the other. The negative plates are each formed with one tag 19 having two parts 19a and 19b on the top edge adjacent the corner with a long edge and the plates are arranged so that the tags 19 form a single row parallel to and spaced apart from the row of tags 17 on the upper edges of the positive plates.

The tags in each upper row lie in general side-by-side arrangement and

are each connected by respective connectors 20 and 21. Two sets of terminals 22 and 23 are integrally formed with the respective connectors 20 and 21, the connectors and terminals being formed by a casting operation. The terminals and connectors are of high conductivity copper, embedded in a lead sheath by a casting process.

Connected to the lower row of tags 18 on the positive plates 11 is a further connector 24 in the form of a strip of lead or lead-sheathed copper which is connected by means of a member in the form of a strip 25 of lead-sheathed copper to the connector at the top of the positive plates 11. The connector 24 and member 25 are joined by any suitable process to one another, to the lower row of tags and to the upper row of tags to make good electrical connections. The lead sheath prevents corrosion by the acid.

As can be seen in the drawing, the further connector 24 lies in a horizontal plane perpendicular to the plane of the plate and the member 25 lies in a vertical plane perpendicular to the plane of the plate except for a small section 26 where it is curved for connection to the further connector 24.

In the second embodiment of the invention, shown in Figure 2, the member of the first embodiment is replaced by a lead sheathed copper strip member 28 having the same general shape and dimensions but positioned between a negative plate 12 and a positive plate 11 (as shown) or at one end of the row of plates so as to lie parallel thereto, and separated from the plates by one or more separating sheets. The tags 18 on the lower edges of the positive plates 11 are replaced by tags 30 on a longer side, adjacent the corner with the lower edge. These tags 30 are connected to a lead sheathed copper or lead strip connector 27 which lies alongside the longer sides of the plates 11 and 12, rather than alongside the lower edge as in the first embodiment.

In this second embodiment any problems associated with plate growth and/or the deposition of debris, are alleviated.

In either embodiment the high conductivity strip member 25 or 28 of copper sheathed with lead may be connected to the lead sheath of the connector 20 or to the copper connector 20 itself. The latter construction has the greater conductivity.

CLAIMS:

1. A battery (10) comprising a housing containing a plurality of positive plates (11) connected in parallel and a plurality of negative plates (12) connected in parallel, the positive plates each being of substantially the same size and rectangular shape having two long edges (16a and 16b) and a first short edge (14) and a second short edge (15), characterised in that the housing also contains a member (25;28) having a first end and a second end, the first end being electrically connected to the first short edges (14) of the positive plates (11) adjacent to one of the two sets of long edges (16a) and the second end being electrically connected to the second short edges (15) of the positive plates (11) adjacent the same set of long edges (16a) or to the same set of long edges (16a) of the positive plates (11) immediately adjacent to the second short edges (15), the member (25;28) extending parallel to the said long edges (16a and 16b) for most its length and consisting of a material which has a greater conductivity than the material of the positive plates (11).

2 A battery (10) according to Claim 1 characterised in that the negative plates (12) are each substantially the same size and rectangular shape having two long edges (16) and a first short edge (14) and a second short edge (15), and a further member (25;28) is provided, the further member having a first end and a second end, the first end being electrically connected to the first short edges (14) of the negative plates (12) and the second end being electrically connected to the second short edges (15) of the negative plates (12) or to one of the long edges (16) of the negative plates (12) immediately adjacent to the second short edges (15), the further member (25;28) consisting of a material which has a greater conductivity than the material of the negative plates (12).

3. A battery (10) according to either Claim 1 or Claim 2 characterised in that the negative plates (12) and the positive plates (11) are all substantially the same size and rectangular shape.

4. A battery (10) according to any one of the preceding claims characterised in that the first short edges (14) of the positive plates are connected by a connector (20) which is electrically connected to a positive terminal (22) of the battery (10).

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5. A battery (10) according to any one of the preceding claims characterised in that the second short edges (15) of the positive plates (12) are connected by a further connector (24).
6. A battery (10) according to Claim 5 characterised in that the further connector (24) is of the same general material as the positive plates (12).
7. A battery (10) according to Claim 5 characterised in that the second connector (24) is of the same general material as the member (25).
8. A battery (10) according to any one of the preceding claims which is a lead acid battery.
9. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises copper covered in a lead sheath.
10. A battery (10) according to claim 9 characterised in that the connector (20) comprises copper covered in lead.
11. A battery (10) according to claim 9 or 10 characterised that the positive terminal (22) comprises copper covered in lead.
12. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises a copper alloy such as brass, covered in a lead sheath.
13. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises aluminium covered in a lead sheath.
14. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises an aluminium alloy covered in a lead sheath.
15. A battery (10) according to any one of Claims 9 to 12 characterised in that the sheath is covered in an acid resistant material such as an epoxy resin.

AMENDED SHEET

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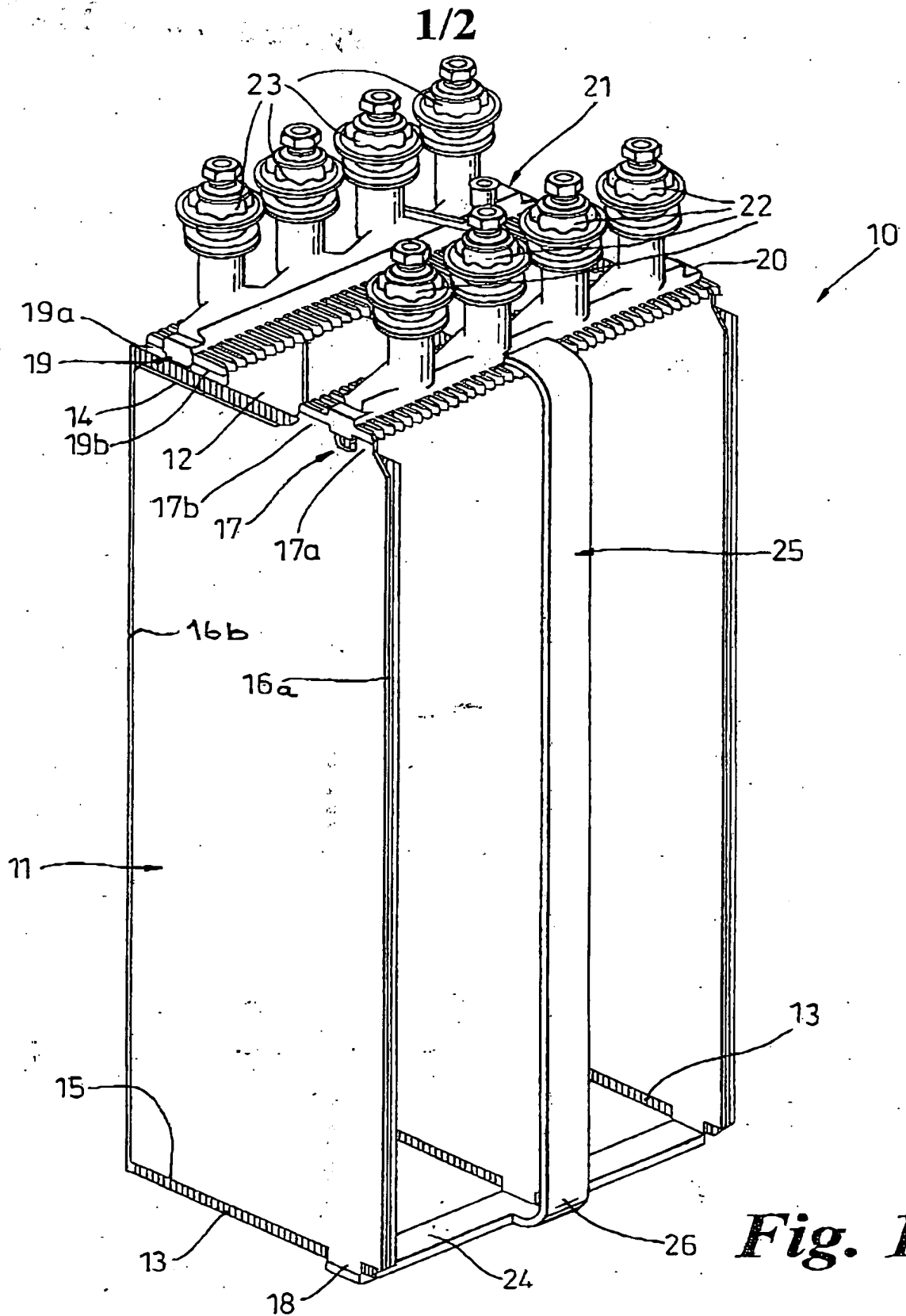
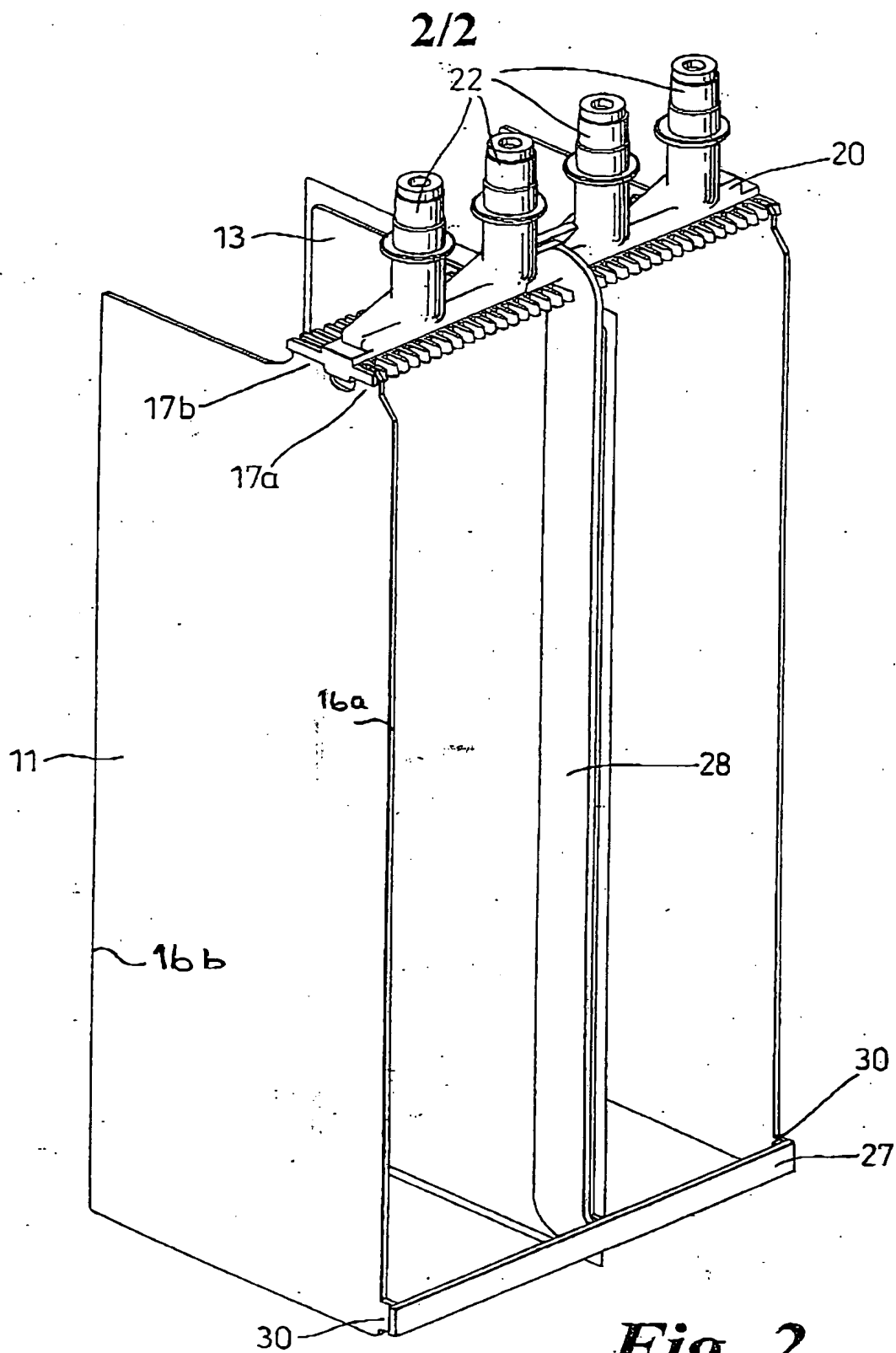


Fig. 1

AMENDED SHEET

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**Fig. 2**

AMENDED SHEET

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BATTERY WITH TOP AND BOTTOM CONNECTING STRAPS AND ADDITIONAL VERTICAL CONNECTING BARS

This invention relates to a battery (also known as an accumulator), particularly but not exclusively of the lead acid type.

One known lead acid battery comprises a plurality of rectangular lead plates arranged parallel to one another and separated by insulating separating sheets. Alternate plates are positive and negative electrodes respectively, all the positive electrodes being connected together electrically by a first connector and all the negative electrodes being connected together electrically by a second connector, the two connectors being connected to positive and negative terminals respectively.

If the plates, all rectangular, are relatively long and narrow, and the connector and/or terminal is connected to a narrow edge, then there is a relatively long conducting path for the current from the area of the plate adjacent the opposite narrow edge to the connector or terminal. Since the conductivity of lead is significantly less than that of a metal such as copper or aluminium, there is a limit to the current carrying capacity of each electrode, since increasing the current increases the heat generated within the plates. Thus, particularly where other factors dictate that a battery has electrodes which are long and narrow, and the terminals or connectors are attached to a narrow edge of the electrodes, and further if the battery is located in a confined space, the limit on the current carrying capacity is a considerable disadvantage.

It is an object of the present invention to provide a battery in which the adverse effects of this disadvantage are reduced, i.e. the current carrying capacity is increased.

In accordance with the invention a battery comprises a housing containing a plurality of positive plates connected in parallel and a plurality of negative plates connected in parallel, the positive plates each being of substantially the same size and rectangular shape having two long edges and a first short edge and a second short edge, and the housing also containing a member having a first end and a second end, the first end being electrically connected to the first short edges of the positive plates and the second end

being electrically connected to the second short edges of the positive plates or to one of the long edges of the positive plates immediately adjacent to the second short edges, the member consisting of a material which has a greater conductivity than the material of the positive plates.

The negative plates may each be substantially the same size and rectangular shape having two long edges and a first short edge and a second short edge, and a further member may be provided, the further member having a first end and a second end, the first end being electrically connected to the first short edges of the negative plates and the second end being electrically connected to the second short edges of the negative plates or to one of the long edges of the negative plates immediately adjacent to the second short edges, the further member consisting of a material which has a greater conductivity than the material of the negative plates.

The negative plates and the positive plates may all be substantially the same size and rectangular shape.

The first short edges of the positive plates may be connected by a first connector which is electrically connected to a positive terminal of the battery.

The second short edges of the positive plates may be connected by a further connector which is either of the same general material as the positive plates, e.g. in the case of a lead acid battery the material is lead, or, alternatively, of the same general material as the member.

If the battery is a lead acid battery, the member preferably comprises copper, or a copper alloy such as brass, or aluminium or an alloy thereof, covered in a lead sheath. The sheath may be covered in an acid resistant material such as an epoxy resin.

Two embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, of which

Figure 1 shows a perspective view of the interior of a lead acid battery according to the first embodiment of the invention, some of the parts being omitted for clarity; and

Figure 2 shows a perspective view of the interior of a battery according

to the second embodiment, only the arrangement of positive plates and attachments being shown.

As shown in Figure 1, the first embodiment of the invention comprises a lead acid battery 10 having a plurality of plates 11 and 12 alternately interleaved with separators 13 comprising sheets of microporous polyethylene and of non-woven glass fibre. The plates 11 and 12 and separators 13 are positioned in face-to-face arrangement and alternate plates are of positive and negative polarity, the positive plates being indicated by reference numeral 11 and the negative plates by reference numeral 12.

The plates and separators are housed in a rectangular container of plastics material (not shown) containing acid (not shown).

All the plates 11 and 12 are generally rectangular in shape and of generally the same size. The horizontal top edge 14 and bottom edge 15 of the plates (as shown) are much shorter than the vertical edges 16. The positive plates 11 are each provided on the top edge with a tag 17, having two parts 17a and 17b, adjacent a corner with a long edge. Directly below, each positive plate is provided on its lower edge with a tag 18 adjacent the corner with the same long edge. The plates are arranged so that the two tags are arranged in two rows, one row directly above the other. The negative plates are each formed with one tag 19 having two parts 19a and 19b on the top edge adjacent the corner with a long edge and the plates are arranged so that the tags 19 form a single row parallel to and spaced apart from the row of tags 17 on the upper edges of the positive plates.

The tags in each upper row lie in general side-by-side arrangement and are each connected by respective connectors 20 and 21. Two sets of terminals 22 and 23 are integrally formed with the respective connectors 20 and 21, the connectors and terminals being formed by a casting operation. The terminals and connectors are of high conductivity copper, embedded in a lead sheath by a casting process.

Connected to the lower row of tags 18 on the positive plates 11 is a further connector 24 in the form of a strip of lead or lead-sheathed copper which

is connected by means of a member in the form of a strip 25 of lead-sheathed copper to the connector at the top of the positive plates 11. The connector 24 and member 25 are joined by any suitable process to one another, to the lower row of tags and to the upper row of tags to make good electrical connections. The lead sheath prevents corrosion by the acid.

As can be seen in the drawing, the further connector 24 lies in a horizontal plane perpendicular to the plane of the plate and the member 25 lies in a vertical plane perpendicular to the plane of the plate except for a small section 26 where it is curved for connection to the further connector 24.

In the second embodiment of the invention, shown in Figure 2, the member of the first embodiment is replaced by a lead sheathed copper strip member 28 having the same general shape and dimensions but positioned between a negative plate 12 and a positive plate 11 (as shown) or at one end of the row of plates so as to lie parallel thereto, and separated from the plates by one or more separating sheets. The tags 18 on the lower edges of the positive plates 11 are replaced by tags 30 on a longer side, adjacent the corner with the lower edge. These tags 30 are connected to a lead sheathed copper or lead strip connector 27 which lies alongside the longer sides of the plates 11 and 12, rather than alongside the lower edge as in the first embodiment.

In this second embodiment any problems associated with plate growth and/or the deposition of debris, are alleviated.

In either embodiment the high conductivity strip member 25 or 28 of copper sheathed with lead may be connected to the lead sheath of the connector 20 or to the copper connector 20 itself. The latter construction has the greater conductivity.

CLAIMS:

1. A battery (10) comprising a housing containing a plurality of positive plates (11) connected in parallel and a plurality of negative plates (12) connected in parallel, the positive plates each being of substantially the same size and rectangular shape having two long edges (16) and a first short edge (14) and a second short edge (15), characterised in that the housing also contains a member (25;28) having a first end and a second end, the first end being electrically connected to the first short edges (14) of the positive plates (11) and the second end being electrically connected to the second short edges (15) of the positive plates (11) or to one of the long edges (16) of the positive plates (11) immediately adjacent to the second short edges (15), the member (25;28) consisting of a material which has a greater conductivity than the material of the positive plates (11).
- 2 A battery (10) according to Claim 1 characterised in that the negative plates (12) are each substantially the same size and rectangular shape having two long edges (16) and a first short edge (14) and a second short edge (15), and a further member (25;28) may be provided, the further member having a first end and a second end, the first end being electrically connected to the first short edges (14) of the negative plates (12) and the second end being electrically connected to the second short edges (15) of the negative plates (12) or to one of the long edges (16) of the negative plates (12) immediately adjacent to the second short edges (15), the further member (25;28) consisting of a material which has a greater conductivity than the material of the negative plates (12).
3. A battery (10) according to either Claim 1 or Claim 2 characterised in that the negative plates (12) and the positive plates (11) are all substantially the same size and rectangular shape.
4. A battery (10) according to any one of the preceding claims characterised in that the first short edges (14) of the positive plates are connected by a connector (20) which is electrically connected to a positive terminal (22) of the battery (10).
5. A battery (10) according to any one of the preceding claims characterised

in that the second short edges (15) of the positive plates (12) are connected by a further connector (24).

6. A battery (10) according to Claim 5 characterised in that the further connector (24) is of the same general material as the positive plates (12).

7. A battery (10) according to Claim 5 characterised in that the second connector (24) is of the same general material as the member (25).

8. A battery (10) according to any one of the preceding claims which is a lead acid battery.

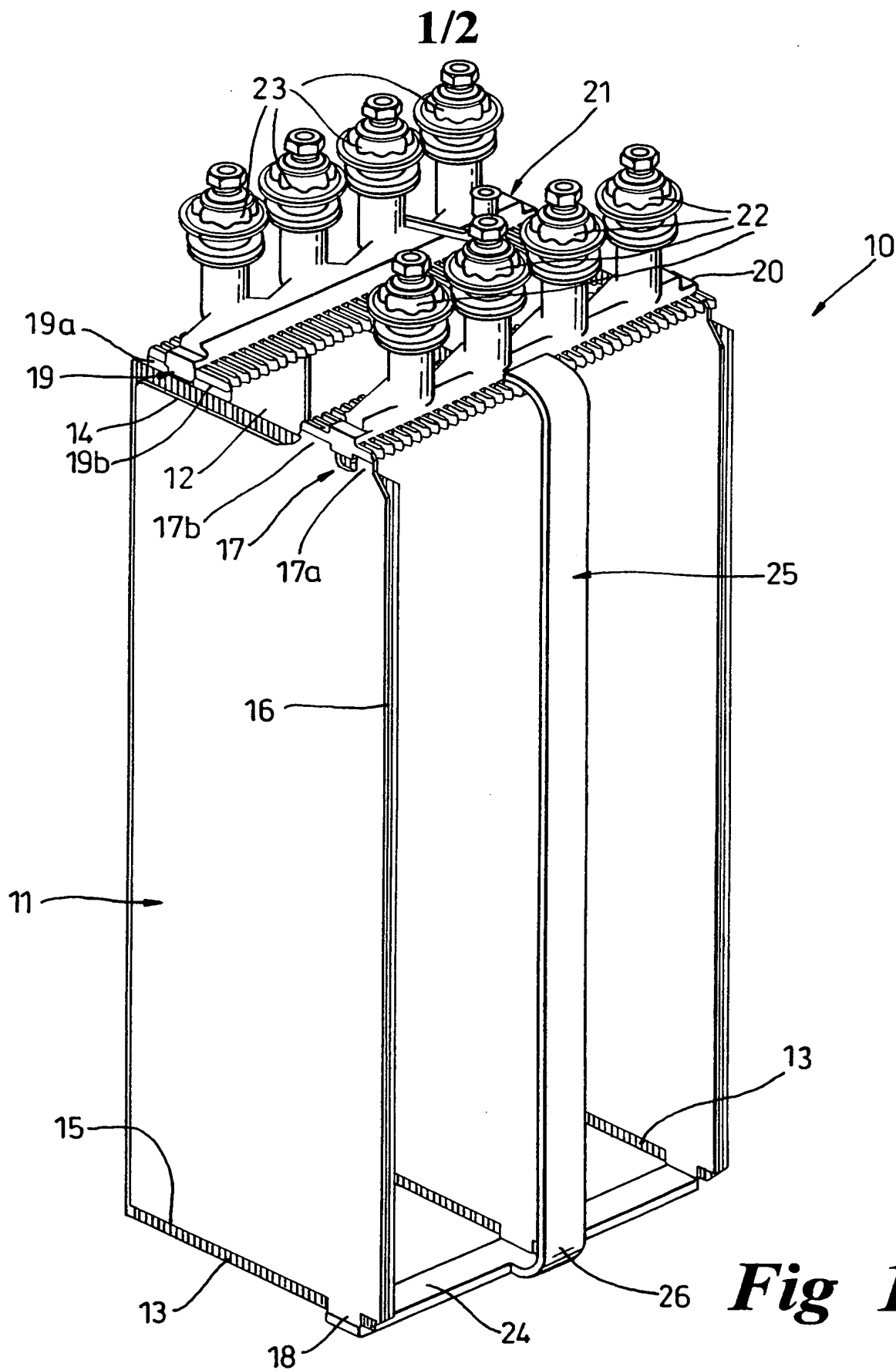
9. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises copper covered in a lead sheath.

10. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises a copper alloy such as brass, covered in a lead sheath.

11. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises aluminium covered in a lead sheath.

12. A battery (10) according to Claim 8 characterised in that the member (25;28) comprises an aluminium alloy covered in a lead sheath.

13. A battery (10) according to any one of Claims 9 to 12 characterised in that the sheath is covered in an acid resistant material such as an epoxy resin.



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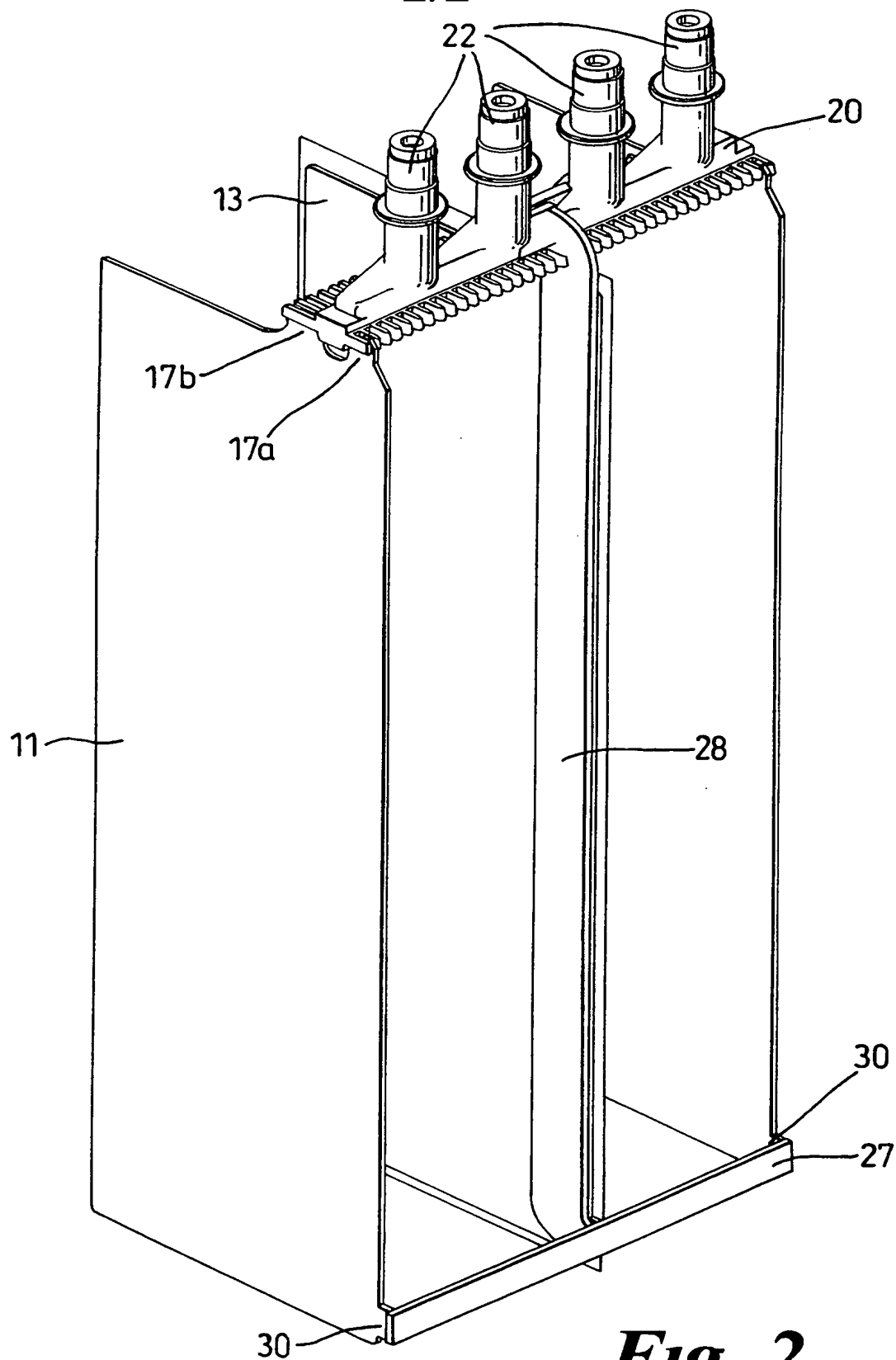


Fig 2

INTERNATIONAL SEARCH REPORT

National Application No.

PCT/GB 99/00194

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H01M2/22 H01M2/28 H01M2/26 H01M10/12 H01M10/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 442 599 A (DELANS DARWIN D) 21 August 1991 see claims see figures	1-13
Y	US 4 760 001 A (NANN EBERHARD ET AL) 26 July 1988 see column 1, line 25-63 see figures	1-3
Y	GB 1 590 947 A (AUERBACH J) 10 June 1981 see page 1, line 44-80 see claims	1-3
Y	EP 0 083 330 A (TUDOR AB) 6 July 1983 see page 1 see claims; figures	1-3

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

21 April 1999

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INTERNATIONAL SEARCH REPORT

International Application No

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